Geoscience and geohazards education research at the University of Canterbury

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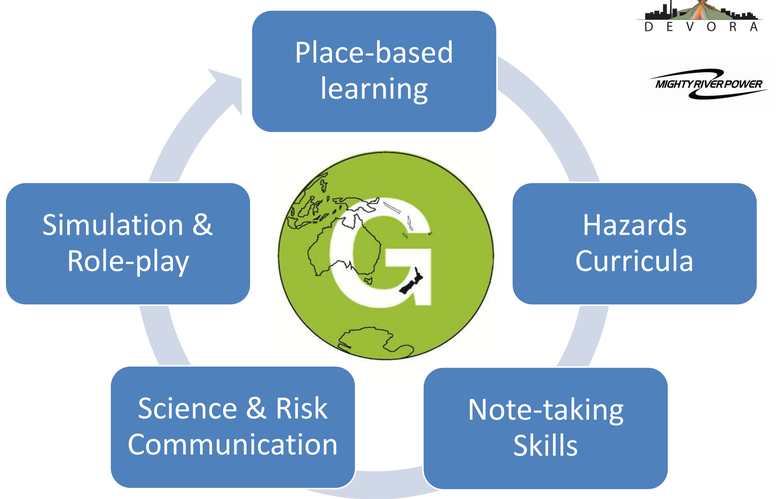
Primary research group goal: Improving tertiary geoscience education practices

- ❑ Develop measures to assess teaching best practices and student performance
- ❑ Develop interactive and cutting edge curricula
- ❑ Improve science communication in graduates
- ❑ Improve science communication best practices (for professionals and to the public)

Multi-faceted Research Group



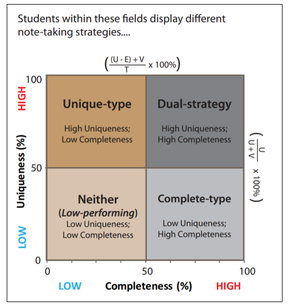
Note-taking Skills

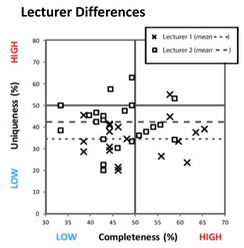
Research Objective:
To characterise the content and perceptions of students' note-taking to deduce strategies students use in the field.

-> The data consisted of **observations** of the 1 hour geothermal field lesson, hard-copy notebooks (n=42), and interview data (n=16).

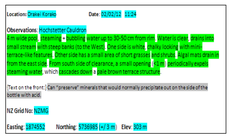
Results:
Analysis of the notebooks revealed note-taking strategies: students preferred to write in their own words (*uniqueness; U*) and some had really complete notes (*completeness; C*).

Several factors influenced the students' notes:
previous field experience, lecturer differences, and gender.

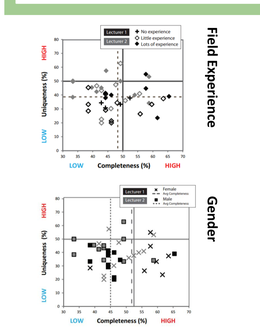




More experienced students (below) wrote their own observations:



Less experienced students copied verbatim what the professors said, and included many extraneous details (red, and pink text below; not observations!)



Place-based Learning

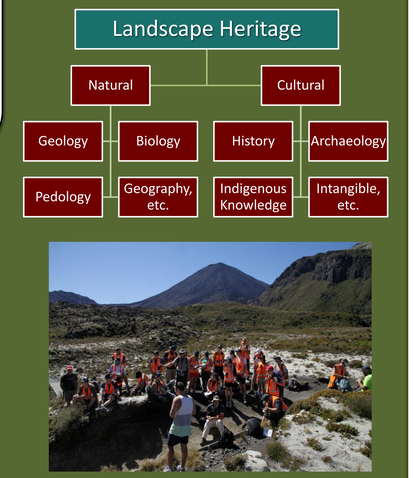
New research initiatives seek to understand how people engage with places of geologic significance in informal and formal learning environments, using the broader notion of **landscape heritage**.

Landscape heritage holistically asks what features, natural and cultural, may be found at a site and how these interact with one another.

In particular, we are interested in student sense of place on undergraduate geology field trips, through diverse experiences and backgrounds.
- How might this be linked to socio-environmental perceptions, and to motivation in the courses?
- How do we impact these with our teaching practices, and how might we respond to a unique set of students?

Sense of Place

- Place Attachment
- Place Dependence
- Place Meanings



Students in the volcanic landscape of the Tongariro Complex, in the North Island of New Zealand

Science Communication

Project Outcome:
Build and **assess** curricula that improves students' communication skills.

Research Objective:
Test & create evidence-based ***measures*** of communication.

1) 'Unpack' Communication *Performance*
2) **Variables/Proxies** of Communication
3) Assessment of communication (via pre-post **interviews**)
4) Compare **proxies** to **interviews.**

Communication Performance

Communication Experience
New validated instrument

Types of Communication:
Oral presentations
Poster presentations
Debates & Speeches
Teaching
Group Discussions & Meetings
Professional Media

Setting/style:
-At conferences, in your department, during your education
-Provided, received or self-evaluative ***feedback*** for communication?

Communication Efficacy
validated instrument

SPCC instrument
1. Present a talk to a group of strangers.
2. Talk with an acquaintance.
3. Talk/Discuss at a large meeting of friends.
4. Talk in a small group of strangers.
5. Talk with a close friend.
6. Talk/Discuss at a large meeting of acquaintances.
7. Talk with a stranger.
8. Present a talk to a group of friends.
9. Talk in a small group of acquaintances.
10. Talk/Discuss at a large meeting of strangers.
11. Talk in a small group of friends.

Geology Content Knowledge

e.g., Earthquake knowledge
✓Earthquake magnitude, depths, types, and frequencies
✓Earthquake mechanisms
✓Earthquake recurrence levels
✓Impacts to infrastructure, human health, economic and social sectors
✓Earthquake preparedness

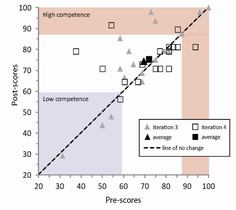
Perceptions of Science Communication
Instrument in development

Delivery
Visual Aids
Media-type
Tone
Intent of message/Purpose

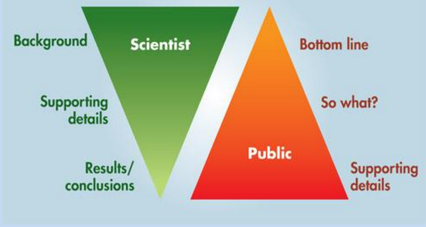
Content
Language & Terms
Amount of content
Level of detail
Diversity of the audience
Acknowledges uncertainty

Different Audiences Scientists, Emergency Managers the Public

Preliminary Results:
Communication Efficacy (SPCC)
A. Changes (Post vs. Pre) role-play



Communicating with the Public



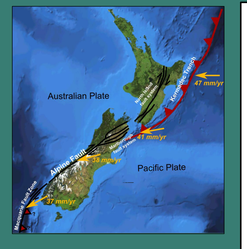
Qualitative Analysis ---> Development of a Rubric

Question: How do scientists actually **know** that a volcano is going to erupt?

Pre-Interview Script:
" That goes back to the monitoring that we are always doing. **Our scientists know when something is happening**, that is different from what we usually see. That's when we will investigate further. And ya know, break it down into what that actually means."

Post-Interview Script:
"So we monitor the volcanoes constantly. And we have different methods of doing this. **Scientists know what to look out for**. We monitor it so frequently that, anything out of character, of the background level, so that we know something is a different kind of activity. So we will look into that further. And from there we can figure out if that is a normal process, or an increase in activity"

Natural Hazards Curricula

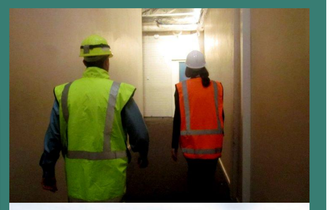


New Zealand, straddling the Australian and the Pacific plates, is a fantastic geological laboratory that is prone to numerous natural hazards.
The Canterbury Earthquake Sequence (2010-2012), which impacted our University severely, was one recent example of that.

Goals:
-Teach students how to manage a natural hazard crisis in a resource and time-constrained environment with conflicting needs and priorities, and justify their decisions.
- Improve skill sets which are important to crisis management (e.g., talking to stakeholders)

Sample activities
❑Workshop to manage the aftermath of a M_w=8.0 Alpine Fault earthquake for industry sectors (first year students)
❑Hazard mapping field exercises to inform the City Council with options for land use (first year students)
❑Risk assessment modelling exercises to inform evacuation planning for an Auckland Volcanic Field eruption (third year students)
❑Press conference exercise regarding an unfolding event with high levels of uncertainty, in collaboration with colleagues and students from Journalism (fourth year students).

Results
✓ Classroom observations show high levels of engagement in the activities.
✓Student feedback indicates that they find the activities challenging, sometimes frustrating (e.g. the workshop going against established expectations) and scary (e.g. facing real journalists). However, students also report finding the activities rewarding, meaningful, and linked to their future professions.
✓The quality of student assessments has improved, showing deeper understanding of the complexities of hazard management, as well as more realistic hazard mitigation thinking.



Students often neglect the complexities of real-life crisis event scenarios where multiple courses of action can be equally valid.

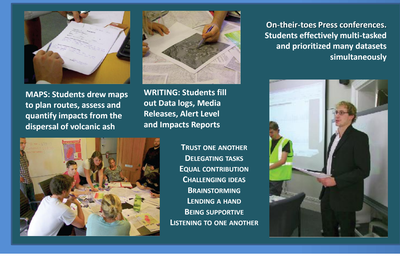
Role-play & Simulation

Simulations of disasters require students to synthesize complex data sets and provide real-time advice in order to minimize impacts from major geologic events.

Project Outcomes:
- Development of highly challenging and engaging geology training simulations for 3rd-4th year undergraduates and postgraduates.

Research Objectives:
- Measure students practical and transferable skills (See panel to the left)
-Evaluate design of simulations (What variables enable positive student engagement and improvement of skill sets?)

Role-play is shown to:
a) Improve problem-solving , decision-making and communication skills
b) increase interpersonal interactions
c) positively change student's attitudes
d) Increase motivation and participation in the learning process



MAPS: Students drew maps to plan routes, assess and quantify impacts from the dispersal of volcanic ash

WRITING: Students fill out Data logs, Media Releases, Alert Level and Impacts Reports

On-their-toes Press conferences. Students effectively multi-tasked and prioritized many datasets simultaneously

Trust one another
Delegating tasks
Equal contribution
Challenging ideas
Brainstorming
Lending a hand
Being supportive
Listening to one another

Simulations:
The Volcanic Hazards Simulation;
-> Instructor guide: **VHUB** (https://vhub.org/resources/3395)
Communicate the Quake (Greymouth, NZ)

Success of the simulation was defined by:
- ✓ The **preparedness** of the students (did they do the pre-readings?),
- ✓ The **pace** (how many tasks, and how quickly the sim went),
- ✓ **Role assignment** (how well-suited were students, to their roles?).

These variables were understood through the lens of **cognitive load** (Chandler and Sweller 1991); **motivational** (Eccles 2005) and **organizational** theories (Argote et al. 2000).

Our website:

Geoscience Education Research Group

http://www.geol.canterbury.ac.nz/geoscience_education/index.shtml

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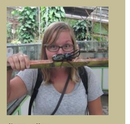

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